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ABSTRACT

A study investigated the question of whether normal and poor readers differ in the way they process sublexical structures in printed words. In a reading level design experiment, two matched groups of normal and poor readers (11 subjects of mean age 9.4 years and 11 subjects of mean age 12.6 years) were compared with regard to their use of sublexical orthographic information in a semantic evaluation task. There were two additional control groups, the first one consisting of 12 age-matched normal readers (mean age 12.4 years), the second one of 15 proficiently reading adults (mean age 19 years). Results showed that poor readers differentially process intra word information. Also striking and informative was the finding that poor readers proved to be relatively insensitive to repeated exposure of the experimental stimuli. (One figure of data is included; a list of the singular-plural pairs presented in the study is attached.) (Author/RS)

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The Use of Orthographic Structure in Normal and Poor Readers

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Paper presented at the 1991 Annual Meeting of the American Educational Research Association, Chicago, IL, April 3-7

Running Head: USE OF ORTHOGRAPHIC STRUCTURE

Abstract

This paper addresses the question if normal and poor readers differ in the way they process sublexical structures in printed words. In a reading level design experiment, two matched groups of normal and poor readers (mean ages 9.4 and 12.6 yrs., respectively) were compared with regard to their use of sublexical orthographic information in a semantic evaluation task. There were two additional control groups, the first one consisting of age matched normal readers (mean age 12.4 yrs), the second one of proficiently reading adults (mean age 19 yrs). The results showed that poor readers differentially process intra word information. Also striking and informative was the finding that poor readers proved to be relatively insensitive to repeated exposure of the experimental stimuli.

This paper addresses the question if normal and poor readers differ in the way they process sublexical structures in printed words. Recent theories assume that words are parsed into sublexical structures such as syllables, morphemes, or BOSSes (Taft, 1979) as part of the recognition process. These sublexical structures are supposed to function as mediators in the recognition process: on the one hand they facilitate the process of initial partitioning the word into smaller perceptual units, on the other hand they subsequently may function as chunks in assembling longer words. Although sublexical chunking possibly is an important mechanism, it should also be realized that there is a growing body of empirical evidence suggesting that the letters and sublexical structures in a word are processed in parallel during identification (McClelland and Rumelhart, 1982).

The purpose of our study was to collect evidence for the hypothesis that orthographic units at a sublexical level play a significant role in word identification. We think that differences in reading ability might originate in or at least be associated with differential use of intraword information. Do normal and poor readers process orthographic information differently when they try to extract meaning from print? Empirical evidence suggesting that poor readers have more difficulty in the use of intraword structure has been presented by Scheerer-Neumann (1981). She demonstrated that parsing and chunking are critical mechanisms in the exploitation of intraword redundancy.

We wanted to collect additional empirical evidence for the hypothesis that normal and poor readers differentially process intraword information when they are engaged in word identification. In order to

demonstrate this we employed a semantic decision task similar to the task described in the study of Jarvella & Snodgrass (1974). We will present a general description of the reading task used in our experiment here.

The semantic decision task used in our experiment consisted of comparing the meanings of pairs of nouns. The language used was Dutch. A pair always consisted of a singular and a plural form. The subject was urged to speeded decision if the members of the pair had identical stem morphemes (roots) or not, (e.g. compare book-books versus brook-books in English). Essential for the experiment were the various classes of singular--plural pairs, as defined by the degree of similarity, or congruence, in orthographic structure between both members of the singular--plural pair. Of special interest was the comparison of decisions relating to orthographically congruent pairs with decisions concerning pairs showing gross intraword orthographic variations. To illustrate, consider the pairs boek-boeken ('book-books') and roos-rozen ('rose-roses'). The first pair represents a perfect sound--spelling correspondence, as well as congruence in orthographic structure, whereas the second pair is exemplifies orthographic incongruence in two respects: the oo of the singular changes into o, and s changes into z.

The second example demonstrates that intra word orthographic structure may vary with grammatical number in Dutch. Our main concern was to find out if normal and poor readers differ in their capacity to process these types of structural variations during word identification.

Method

Subjects

Two matched groups of normal and poor readers participated in the experiment. The poor readers attended a school for learning disabilities to improve their reading skills. These Ss. (n=11; mean age 12.6 yrs) were matched with a group of normal readers (n=11; mean age 9.4 yrs) on a standard Dutch reading ability test (Brus & Voeten, 1972). There were two additional control groups, one consisting of age matched normal readers (n=12; mean age 12.4 yrs), the second group consisted of proficiently reading adults (n=15; mean age 19 yrs). All Ss. were native speakers.

Materials

The following types of singular-plural pairs were used as items:

1. Items representing perfect sound-spelling correspondence, e.g. boek-boeken 'book-books';

2. Items showing congruent orthographic structure, but phonologically incongruent in the singular, e.g. paard-paarden [pa:rt/pa:rd n] ('horse-horses');

3. Phonologically congruent , but morphologically incongruent items e.g. huis-huizen 'house-houses';

4. Similar to type 3, but with additional alternating vowel orthography, e.g. baas-bazen [ba:s/ba:z n] ('boss-bosses');

5. Items showing reduplication of the final consonant in the plural, e.g. fles-flessen 'bottle-bottles';

6. Items showing an alternating vowel orthography, e.g. droom-dromen [dro:m/dro:m n] 'dream-dreams'.

7. Items showing semantically related pairs, with a strong plural formation, e.g. stad-steden 'town-towns';

In addition to these seven types of experimental items there were three types of control items:

8. Semantically unrelated pairs, e.g. bloem-bomen 'flower-trees';

9. Semantically unrelated, but acoustically similar items, e.g. boek-boeren 'book-peasants';

10. Semantically unrelated, but orthographically interfering items, e.g. bom-bomen [bom/bo:m n] 'bomb-trees'.

The complete list of stimuli used is presented in the Appendix.

Procedure and Design

The pairs of nouns were presented on a computer monitor screen. Each pair was presented twice, once with the singular form as the left member of the pair and once vice versa. Sequence of this repeated left-right presentation was random. Moreover, experimental and control pairs were never presented more than three times in succession. The same held for singular-plural presentation order. An IBM Personal Computer with a monochrome cathode-ray tube (CRT) display with a 60 Hz refresh rate and a 9x14 letter raster was used. Ss. were instructed by the experimenter. All items were presented in capital letters. Ss. responded by pushing one of two buttons, a green one for 'yes' (semantically related) and a red one for 'no' responses.

Results

A MANOVA on the RT scores on the 7 experimental item types showed main effects for Group $F(3,45)=33.13$, $p<0.001$, Repetition $F(1,45)=42.28$, $p<.001$ and Type $F(6,270)=7.70$, $p<0.001$. There were 1-st order interactions for Group x Repetition $F(3,45)=5.56$, $p<.002$ and for Group x Type $F(18,270)=1.62$, $p=0.05$. Finally, there was a 2-nd order interaction for Group x Type x Repetition $F(18,270)=2.61$, $p<0.001$.

Post hoc analyses of the type effect showed that this effect was brought about by types C (buis-buizen), F (droom-dromen) and G (schip-schepen). These types show unmistakable intra-word alternations in orthographic structure taking longer decision times. The Group by Repetition effect showed that the younger, less experienced readers profited less from repeated exposure of the stimuli.

For specific contrasts focussing on differences between the two groups of normal and poor readers matched on reading level an additional MAVOVA was executed. This analysis showed no main effect of Group, $F(1,20)= 0.17$. There were main effects of Type $F(6,120)=4.65$, $p<0.001$ and Repetition $F(1,20)=15.88$, $p<.001$. There was a 1-st order interaction for Group x Repetition $F(1,20)=9.16$, $p<.007$. Finally, there was a 2-nd order Group x Type x Repetition interaction $F(6,120)=2.64$, $p<0.019$. Post hoc analyses of the Type effect showed that the types showing intra word orthographic alternations were responsible for it: that is types C (buis-buizen), F (droom-dromen) and G (schip-schepen). The main results are graphically represented in figure 1:

(insert Figure 1 here)

A post hoc analysis of the Group x Type x Repetition 2nd-order interaction showed that poor readers significantly profited less of repeated presentation of types F and G, $F(1,20)=5.65$, $p<.027$ and $F(1,20)=4.51$ $p<.046$, respectively.

Discussion

One of the most striking outcomes of this study is that the two matched groups did not differ in their overall capacity in decision speed. Rather, they showed differences in the speed of their response dependent of word structure, in association with prior exposure.

The results obtained in our experiment strongly suggest that poor readers who are beyond the stage of initial instruction encounter specific problems in evaluating the semantic identity of words showing intraword variations across syntactic functions. Perhaps the most striking outcome obtained is that the poor readers participating in our experiment turned out to be less sensitive to repeated presentation of the items containing alternations in intraword structure. This finding in particular gives us a clue as to the specific problems encountered by poor readers. In normal circumstances, word identification seems to be accelerated by speeded segmentation of the intraword letter clusters. In other words, the automatic processing of words is at least partially dependent on identification routines working on a subword level. It would be interesting to verify the implication that the effects reported here

are assumed to be relatively language independent. Finally, our findings suggest that reading instruction should be more focussed on the explicit training of decoding routines tapping the identification of intraword clusters or orthographic units more directly.

Author Identification Note

The authors wish to express their gratitude to Wytse de Jong, who contributed significantly to the research reported here. Correspondence concerning this paper should be sent to either author at the Department of Psychology, University of Utrecht, Heidelberglaan 2, 3584 CS Utrecht, The Netherlands.

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Appendix

SINGULAR-PLURAL PAIRS[1] PRESENTED IN THE EXPERIMENT

A. Perfect sound-spelling congruence
broek-broeken (27) fiets-fietsen (42)
plant-planten (45) lijst-lijsten (32)

B. Morphological congruence, phonologically incongruent
bord-borden (27) meid-meiden (22)
rand-randen (36) hond-honden (57)

C. Phonological congruence, morphologically incongruent
buis-buizen (14) proef-proeven (20)
reis-reizen (55) lijf-lijven (39)

D. As C; additional alternating vowel orthography
baas-bazen (44) roos-rozen (14)
slaaf-slaven (13) kaas-kazen (24)

E. Consonant reduplication in the plural
bril-brillen (44) knop-knoppen (23)
trap-trappen (59) fles-flessen (31)

F. Alternating orthography of the long vowel
droom-dromen (31) muur-muren (51)
steen-stenen (67) maat-maten (37)

G. Strong plural
schip-schepen (68) glas-glazen (68)
smid-smeden (0) stad-steden (119)

(continued)

[1]Pairs A to G were presented twice, one time with the singular form first and once vice versa. Thus, all semantically related pairs appeared two times on the CRT screen. Printed word frequency (Uit den Boogaart, 1975) is presented in parentheses.

H. Semantically unrelated (control pairs)

riem-bladen	pruim-lampen	krant-platen
lijn-palen	plan-boorden	kaars-touwen
huis-botten	kraal-benen	helm-bakken

I. Semantically unrelated, acoustically similar (control pairs)

stoep-stoelen	vorm-vorken	walm-walsen
kuip-kuilen	pauk-pauwen	peul-peuken
buil-buiken	dier-dieven	boer-boeven

J. Semantically unrelated, orthographically similar (control pairs)

bas-bazen	bom-bomen	ton-tonen
lof-loven	poot-potten	boot-botten
koop-koppen	pool-pollen	lees-lessen

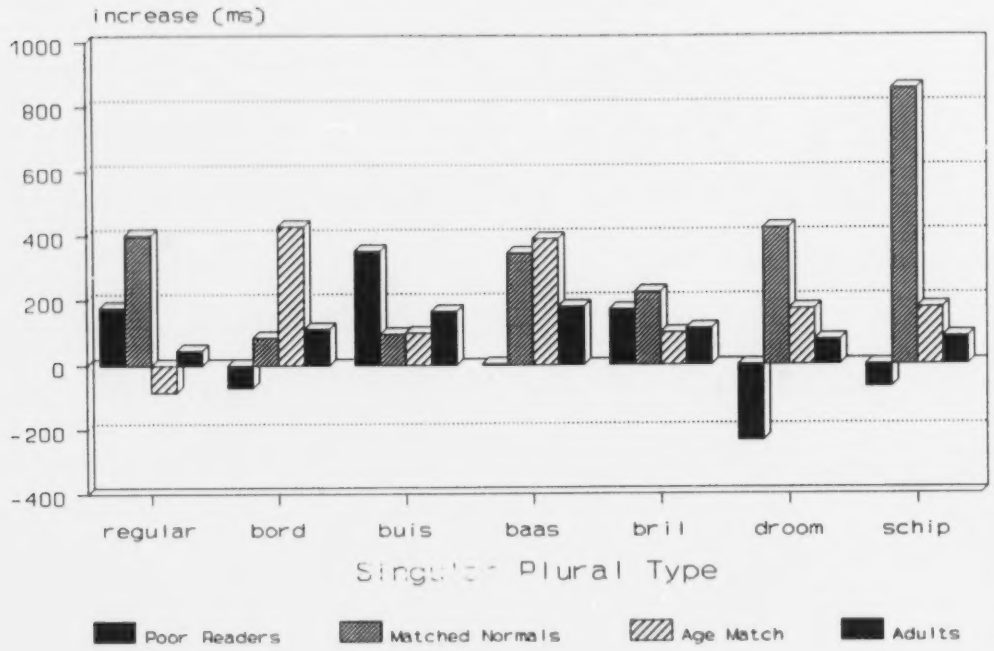

Fig. 1 Increase in Decision Speed